SGS-THOMSON MICROELECTRONICS

HCC/HCF4095B
HCC/HCF4096B

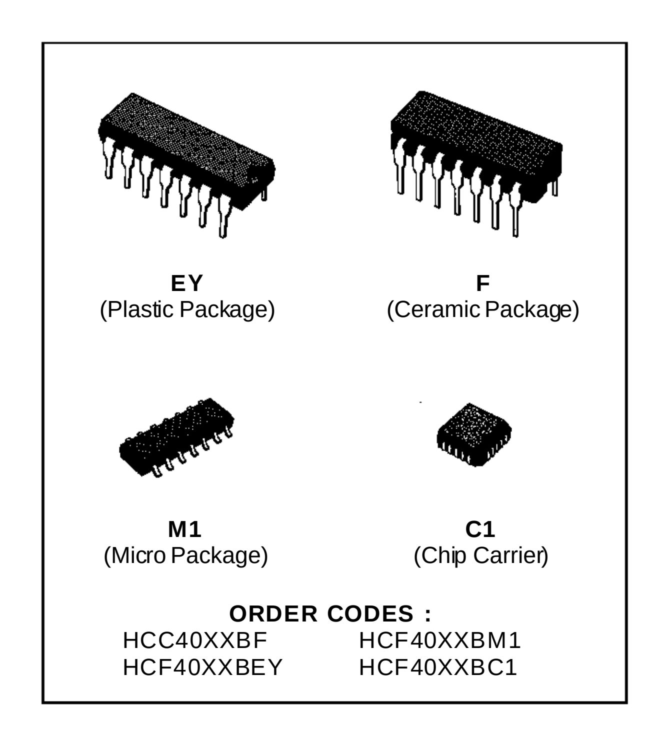
GATE J-K MASTER-SLAVE FLIP-FLOPS

- 16 MHz TOGGLE RATE (typ.) AT V_{DD} - V_{SS} = 10V
- GATED INPUTS
- QUIESCENT CURRENT SPECIFIED TO 20v FOR HCC DEVICE
- 5V, 10V AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100 nA AT 18V AND 25°C FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD No 13 A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF B SERIES CMOS DEVICES"

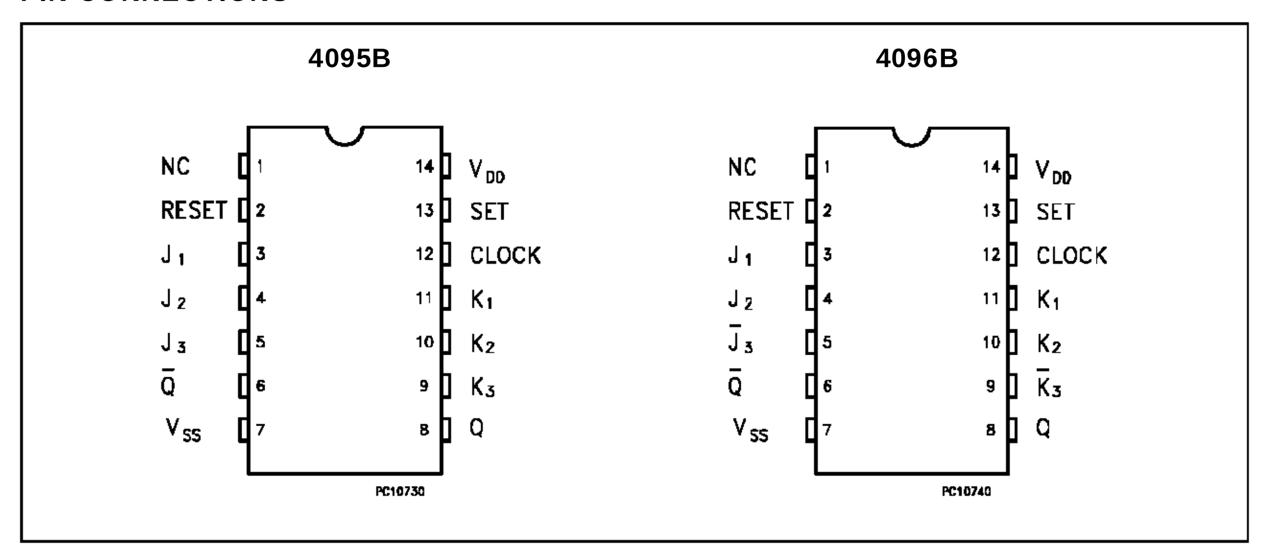
DESCRIPTION

The **HCC4095B/4096B** (extended temperature range) and **HCF4095B/4096B** (intermediate temperature range) are monolithic integrated circuits, available in 14 lead dual in-line plastic or ceramic package and plastic micropackage.

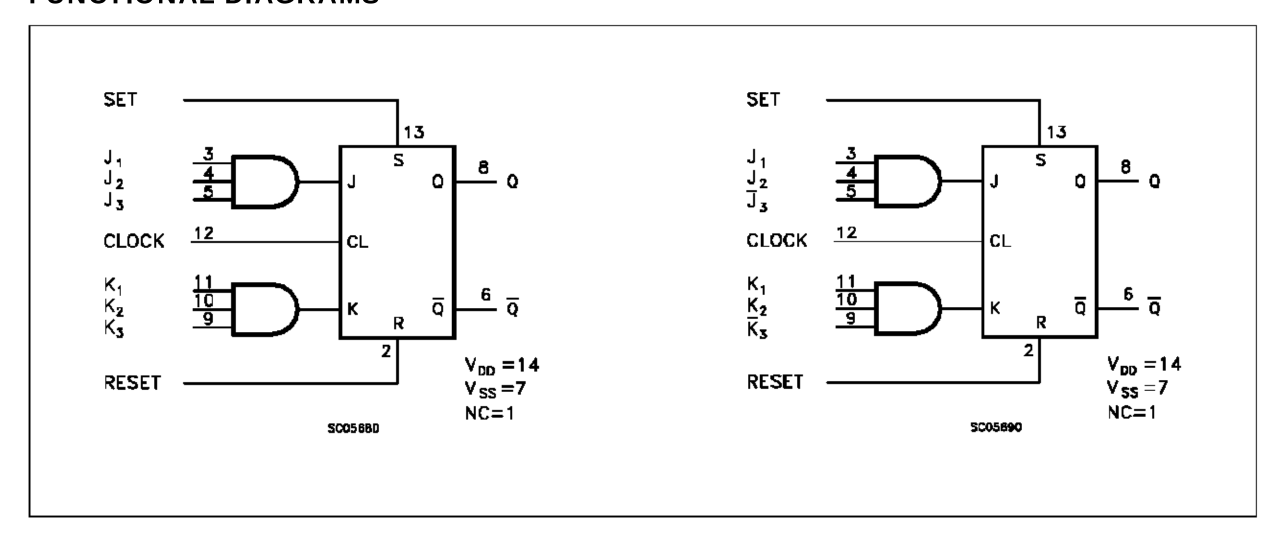
The **HCC/HCF4095B** and **HCC/HCF4096B** are J-K Master-Slave Flip-Flops featuring separate AND gating of multiple J and K inputs. The gated J-K input control transfer of information into the master section during clocked operation. Information on the J-K inputs is transferred to the Q and $\overline{Q}$ outputs on the positive edge of the clock pulse. SET and RESET inputs (active high) are provided for asynchronous operation.



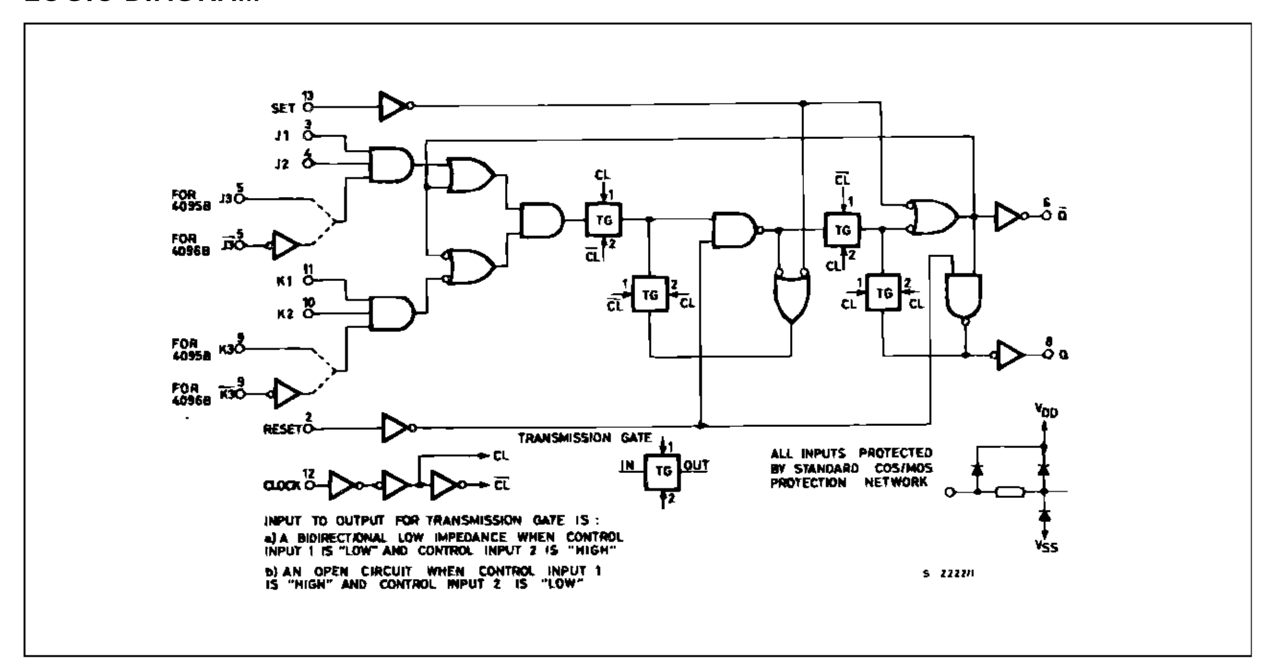
PIN CONNECTIONS



FUNCTIONAL DIAGRAMS



LOGIC DIAGRAM



TRUTH TABLES

SYNCHRONOUS OPERATION (S=0 R=0)

Inputs Before Positive Clock Transition		Outputs After Positive Clock Transition	
J *	K *	Q	$\overline{Q}$
0	0	No Change	
0	1	0	1
1	0	1	0
1	1	Toggles	

* For 4095B $J = J1 \bullet J2 \bullet \overline{J3}$, $K = K1 \bullet K2 \bullet \overline{K3}$
* For 4095B $J = J1 \bullet J2 \bullet \overline{J3}$, $K = K1 \bullet K2 \bullet \overline{K3}$

ASYNCHRONOUS OPERATION (J and K DON'T CARE)

S	R	Q	$\overline{Q}$
0	0	No Change	
0	1	0	1
1	0	1	0
1	1	0	0

0 = V_{SS}, 1 = V_{DD}



ABSOLUTE MAXIMUM RATING

Symbol	Parameter	Value	Unit
V_{DD} *	Supply Voltage: **HCC** Types **HCF** Types	-0.5 to +20 -0.5 to +18	V V
V_i	Input Voltage	-0.5 to V_{DD} + 0.5	V
I_I	DC Input Current (any one input)	± 10	mA
P_{tot}	Total Power Dissipation (per package) Dissipation per Output Transistor for Top = Full Package Temperature Range	200 100	mW mW
T_{op}	Operating Temperature: **HCC** Types **HCF** Types	-55 to +125 -40 to +85	°C °C
T_{stg}	Storage Temperature	-65 to +150	°C

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for external periods may affect device reliability.

* All voltage values are referred to V_{SS} pin voltage.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{DD}	Supply Voltage: **HCC** Types **HCF** Types	3 to 18 3 to 15	V V
V_I	Input Voltage	0 to V_{DD}	V
T_{op}	Operating Temperature: **HCC** Types **HCF** Types	-55 to +125 -40 to +85	°C °C

STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

Symbol	Parameter		Test Conditios				Value							Unit
			V_I (V)	V_O (V)	$\|I_O\|$ (μA)	V_{DD} (V)	T_{LOW} *		25 °C			T_{HIGH} *		
							Min.	Max.	Min.	Typ.	Max.	Min.	Max.	
I_L	Quiescent Current	HCC Types	0/5			5		1		0.02	1		30	μA
			0/10			10		2		0.02	2		60	
			0/15			15		4		0.02	4		120	
			0/20			20		20		0.04	20		600	
		HCF Types	0/5			5		4		0.02	4		30	
			0/10			10		8		0.02	8		60	
			0/15			15		16		0.02	16		120	
V_{OH}	Output High Voltage		0/5		< 1	5	4.95		4.95			4.95		V
			0/10		< 1	10	9.95		9.95			9.95		
			0/15		< 1	15	14.95		14.95			14.95		
V_{OL}	Output Low Voltage		5/0		< 1	5		0.05			0.05		0.05	V
			10/0		< 1	10		0.05			0.05		0.05	
			15/0		< 1	15		0.05			0.05		0.05	
V_{IH}	Input High Voltage			4.5	< 1	5	3.5		3.5			3.5		V
				9	< 1	10	7		7			7		
				13.5	< 1	15	11		11			11		
V_{IL}	Input Low Voltage			0.5	< 1	5		1.5			1.5		1.5	V
				1	< 1	10		3			3		3	
				1.5	< 1	15		4			4		4	
I_{OH}	Output Drive Current	HCC Types	0/5	2.5		5	-2		-1.6	-3.2		-1.15		mA
			0/5	4.6		5	-0.64		-0.51	-1		-0.36		
			0/10	9.5		10	-1.6		-1.3	-2.6		-0.9		
			0/15	13.5		15	-4.2		-3.4	-6.8		-2.4		
		HCF Types	0/5	2.5		5	-1.53		-1.36	-3.2		-1.1		
			0/5	4.6		5	-0.52		-0.44	-1		-0.36		
			0/10	9.5		10	-1.3		-1.1	-2.6		-0.9		
			0/15	13.5		15	-3.6		-3.0	-6.8		-2.4		
I_{OL}	Output Sink Current	HCC Types	0/5	0.4		5	0.64		0.51	1		0.36		mA
			0/10	0.5		10	1.6		1.3	2.6		0.9		
			0/15	1.5		15	4.2		3.4	6.8		2.4		
		HCF Types	0/5	0.4		5	0.52		0.44	1		0.36		
			0/10	0.5		10	1.3		1.1	2.6		0.9		
			0/15	1.5		15	3.6		3.0	6.8		2.4		
I_{IH}, I_{IL}	Input Leakage Current		0/18	Any Input		18		±0.1		$\pm10^{-5}$	±0.1		±1	μA
			0/15			15		±0.3		$\pm10^{-5}$	±0.3		±1	
C_I	Input Capacitance			Any Input						5	7.5			pF

* T_{LOW} = -55 °C for **HCC** device: -40 °C for **HCF** device.

* T_{HIGH} = +125 °C for **HCC** device: +85 °C for **HCF** device.

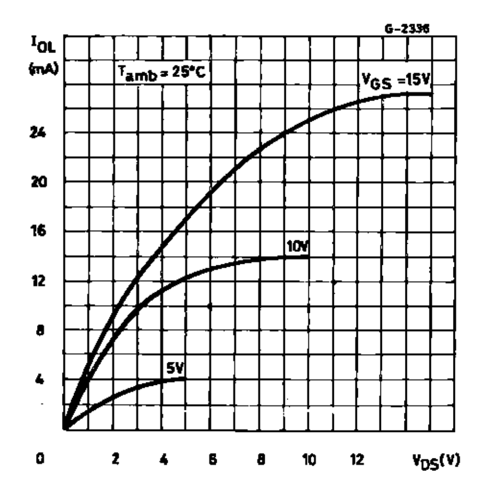
The Noise Margin for both "1" and "0" level is: 1V min. with V_{DD} = 5 V, 2 V min. with V_{DD} = 10 V, 2.5 V min. with V_{DD} = 15 V



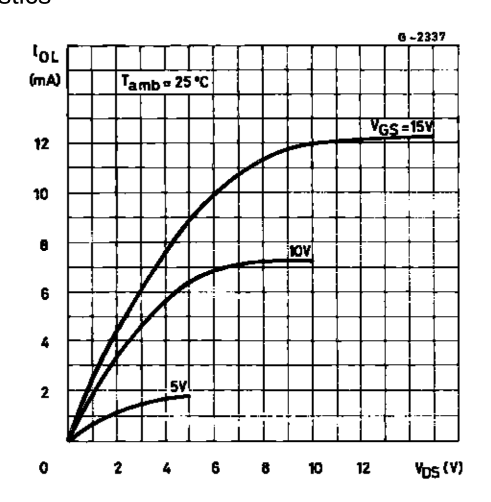
DYNAMIC ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C, C_L = 50 pF, R_L = 200 KΩ, typical temperature coefficent for all V_{DD} values is 03 %/°C, all input rise and fall times= 20 ns)

Symbol	Parameter	Test Conditions		Value			Unit
			V_{DD} (V)	Min.	Typ.	Max.	
t_{PLH} t_{PHL}	Propagation Delay Time		5		250	500	ns
			10		100	200	
			15		75	150	
t_{PLH} t_{PHL}	Propagation Delay Time (Set or Reset)		5		150	300	ns
			10		75	150	
			15		50	100	
t_{THL} t_{TLH}	Transition Time		5		100	200	ns
			10		50	100	
			15		40	80	
f_{CL}	Maximum Clock Input Frequency		5	3.5	7		MHz
			10	8	16		
			15	12	24		
t_W	Clock Pulse Width		5	140	70		ns
			10	60	30		
			15	40	20		
t_r t_f	Clock Input Rise or Fall Time		5			15	µs
			10			5	
			15			5	
t_W	Set or Reset Pulse Width		5	200	100		ns
			10	100	50		
			15	50	25		
t_{setup}	Data Setup Time		5	400	200		ns
			10	160	80		
			15	100	50		

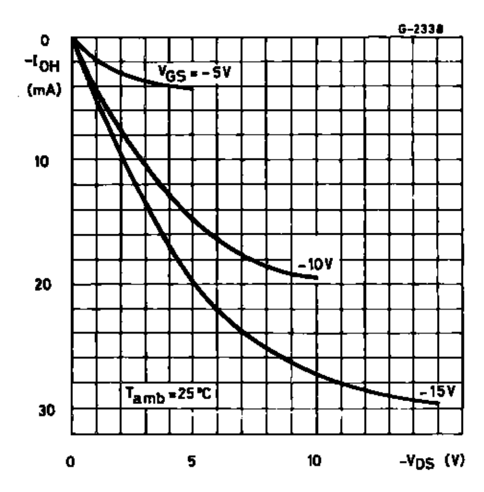
Typical Output Low (sink) Current Characteristics



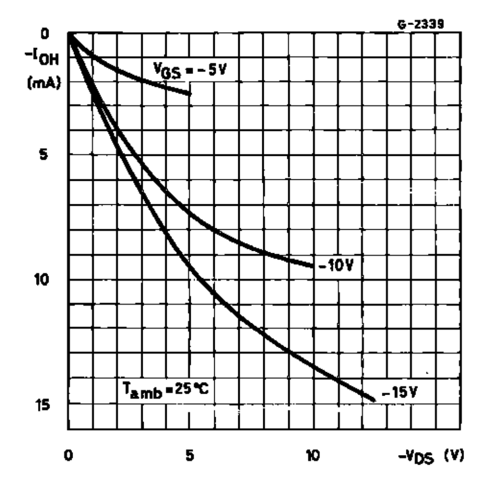
Minimum Output low (sink) Current Characteristics



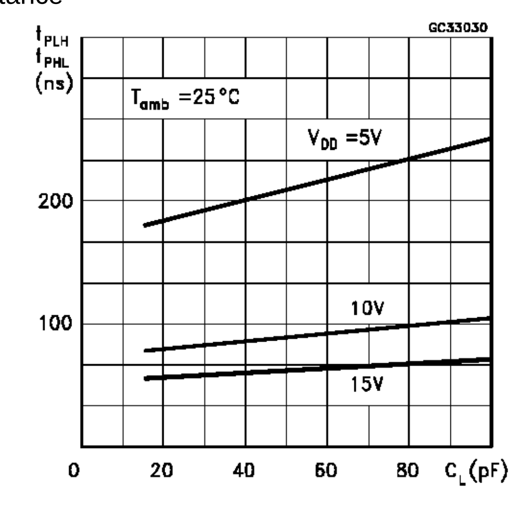
Typical Output High (source) Current Characteristics



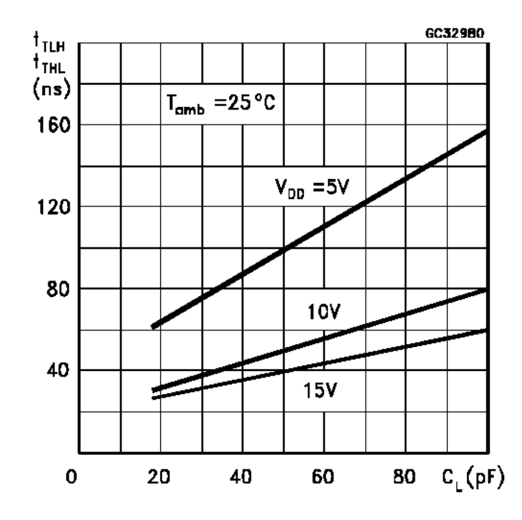
Minimum Output High (source) Current Characteristics



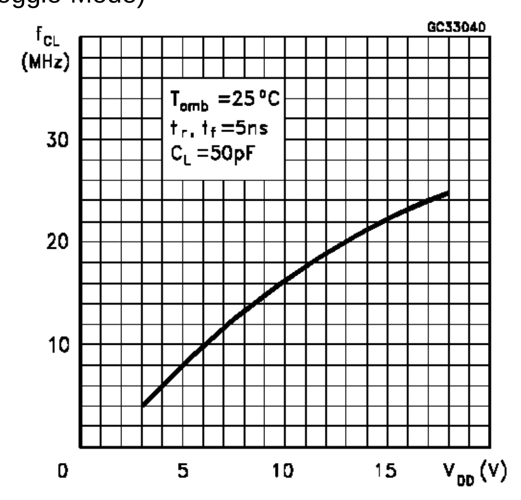
Typical Propagation Delay Time vs Load Capacitance



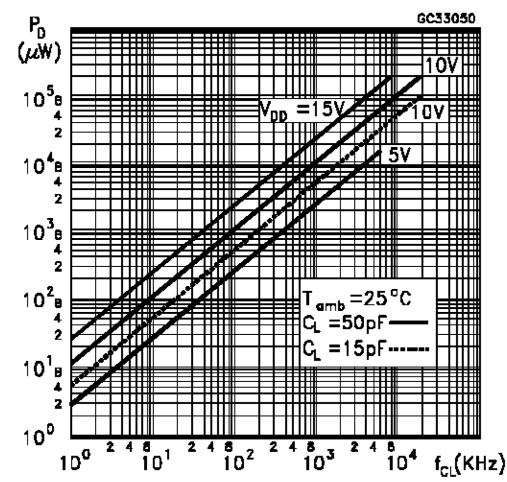
Typical Transition Time vs Load Capacitance



Typical Clock Frequency vs Supply Voltage (Toggle Mode)

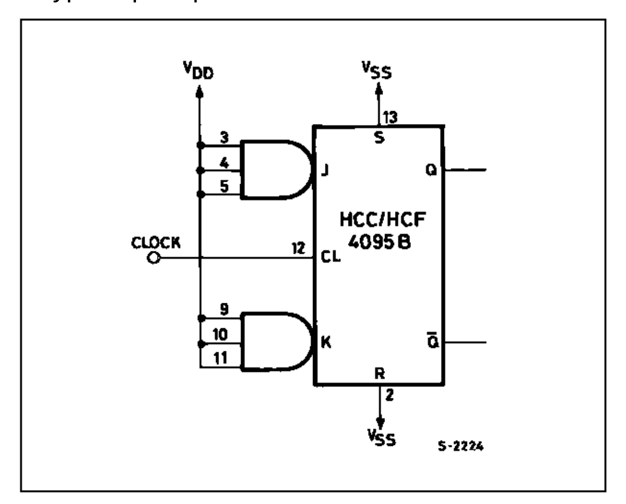


Typical Power Power Dissipation Vs. Input Clock Frequency

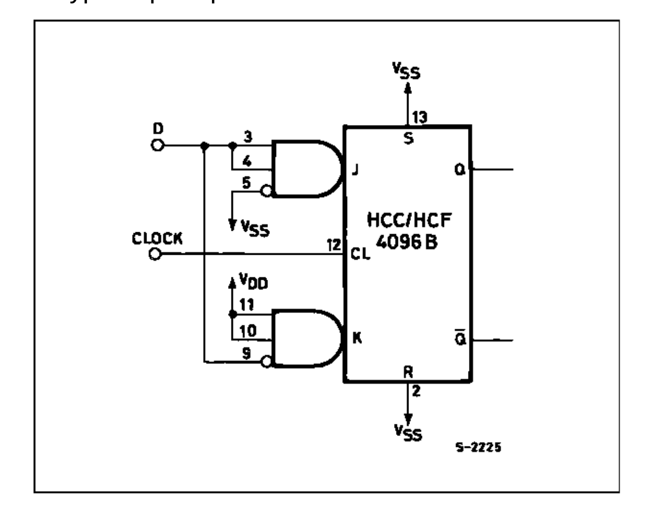


TYPICAL APPLICATIONS

T-type Flip-Flop



D-type Flip-Flop



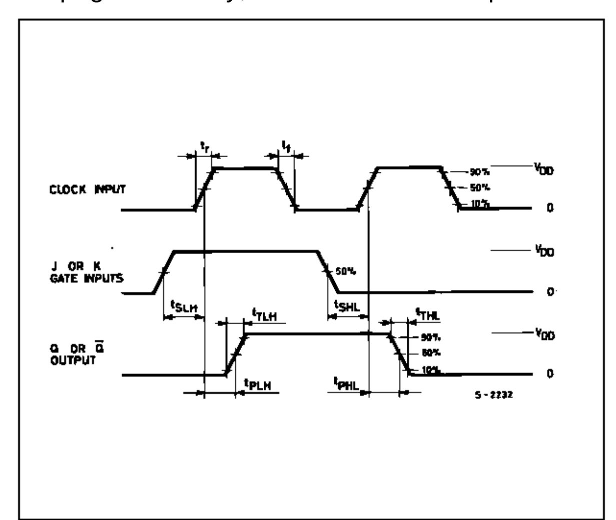
Synchronous Binary Divide by Ten Counter

STATE	QA	QB	QC	QD
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1

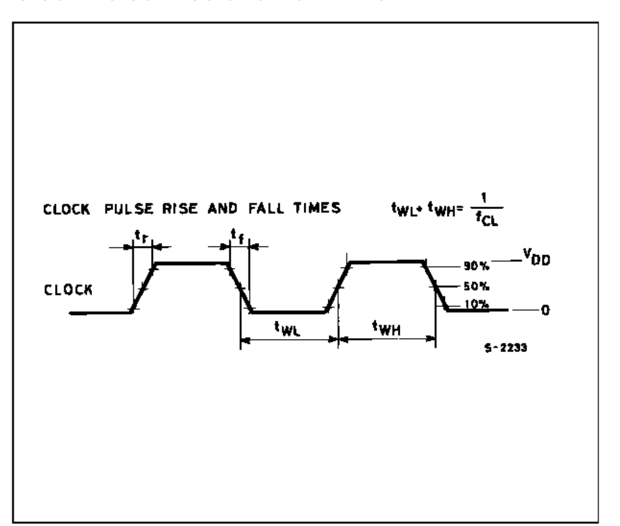
NOTE: In all 4095B units the Set and Reset are Connected to V_{SS}

WAVEFORMS

Propagation Delay, Transition and Setup Time

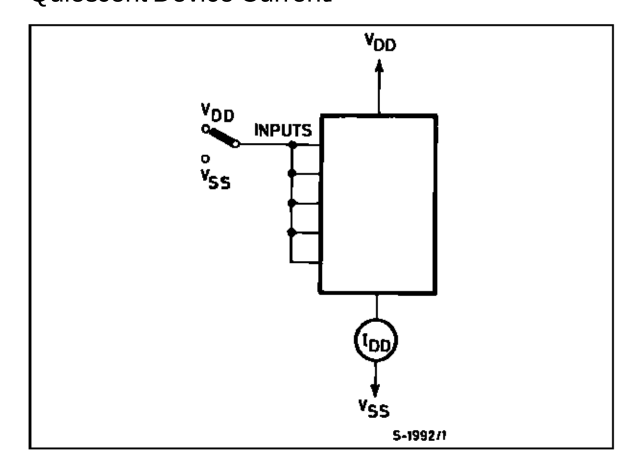


Clock Pulse Rise and Fall Time

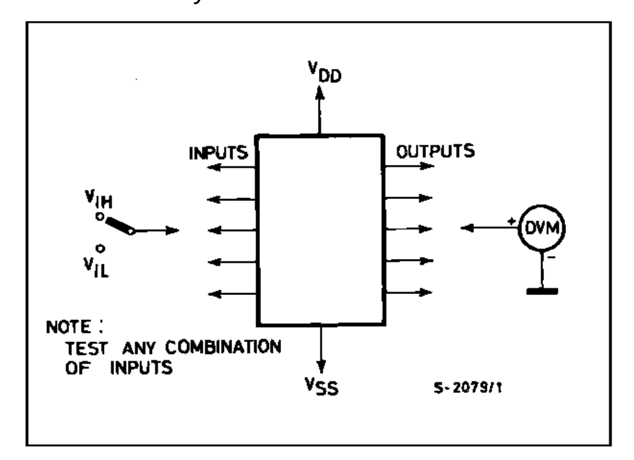


TEST CIRCUITS

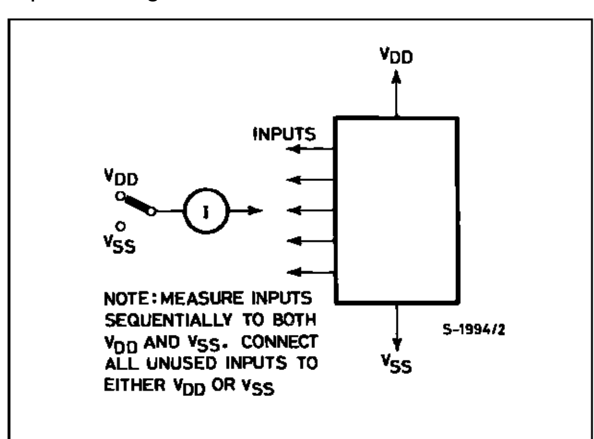
Quiescent Device Current.



Noise Immunity.



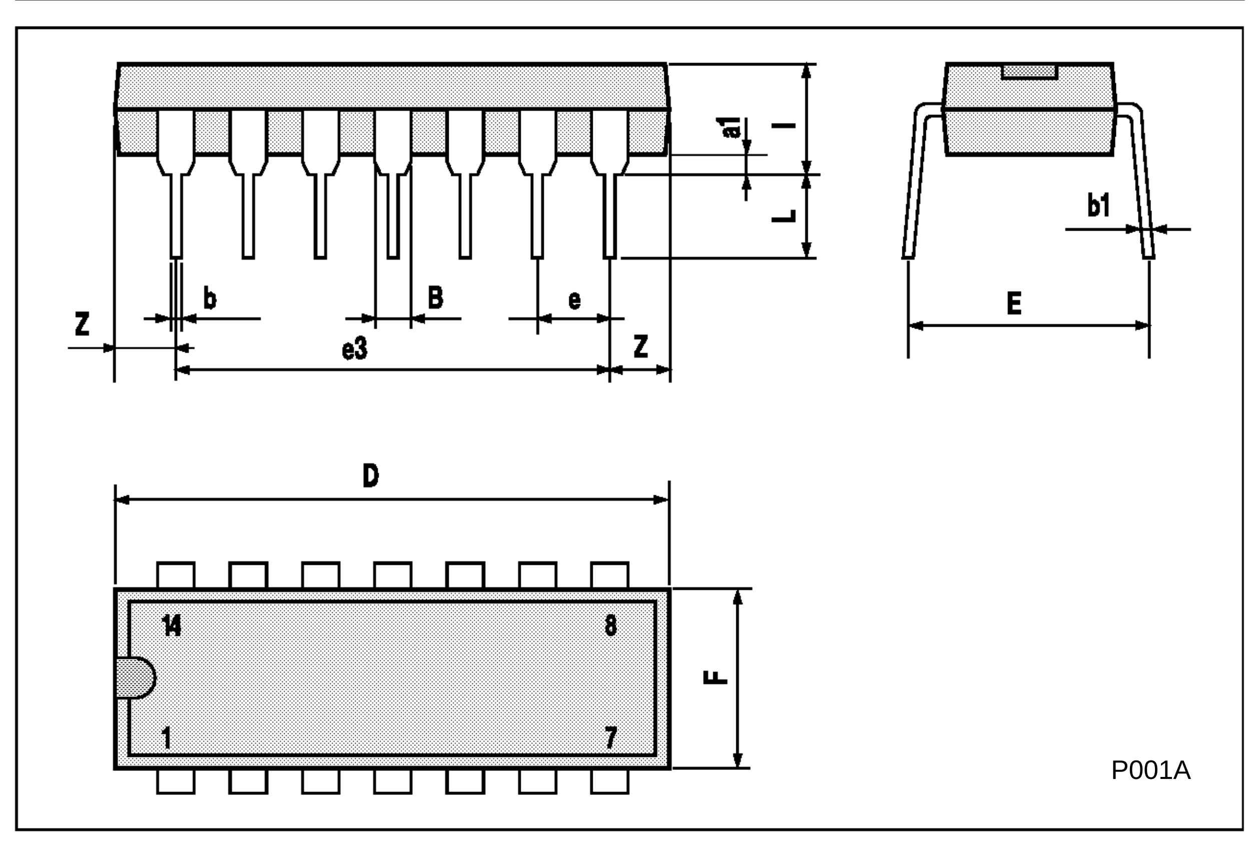
Input Leakage Current.





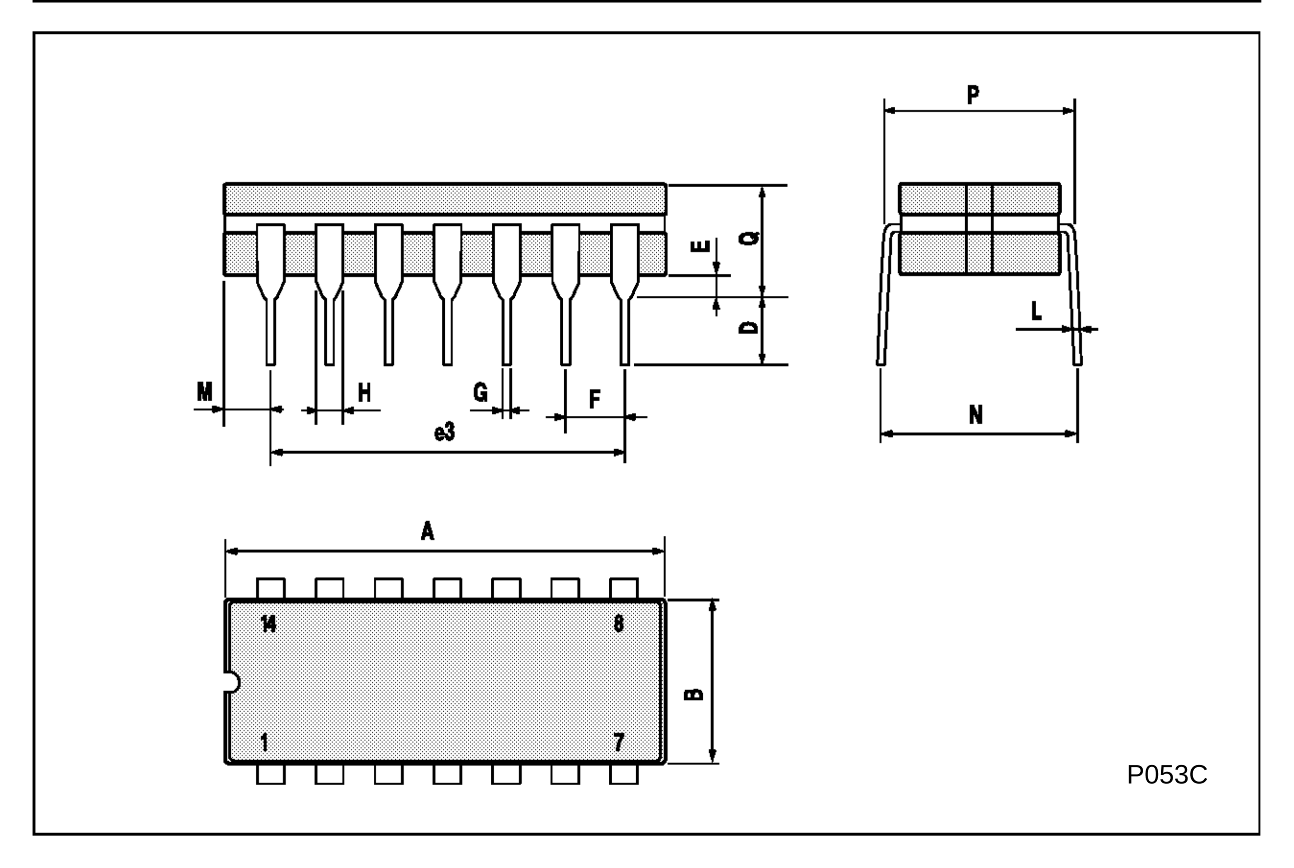
Plastic DIP14 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100



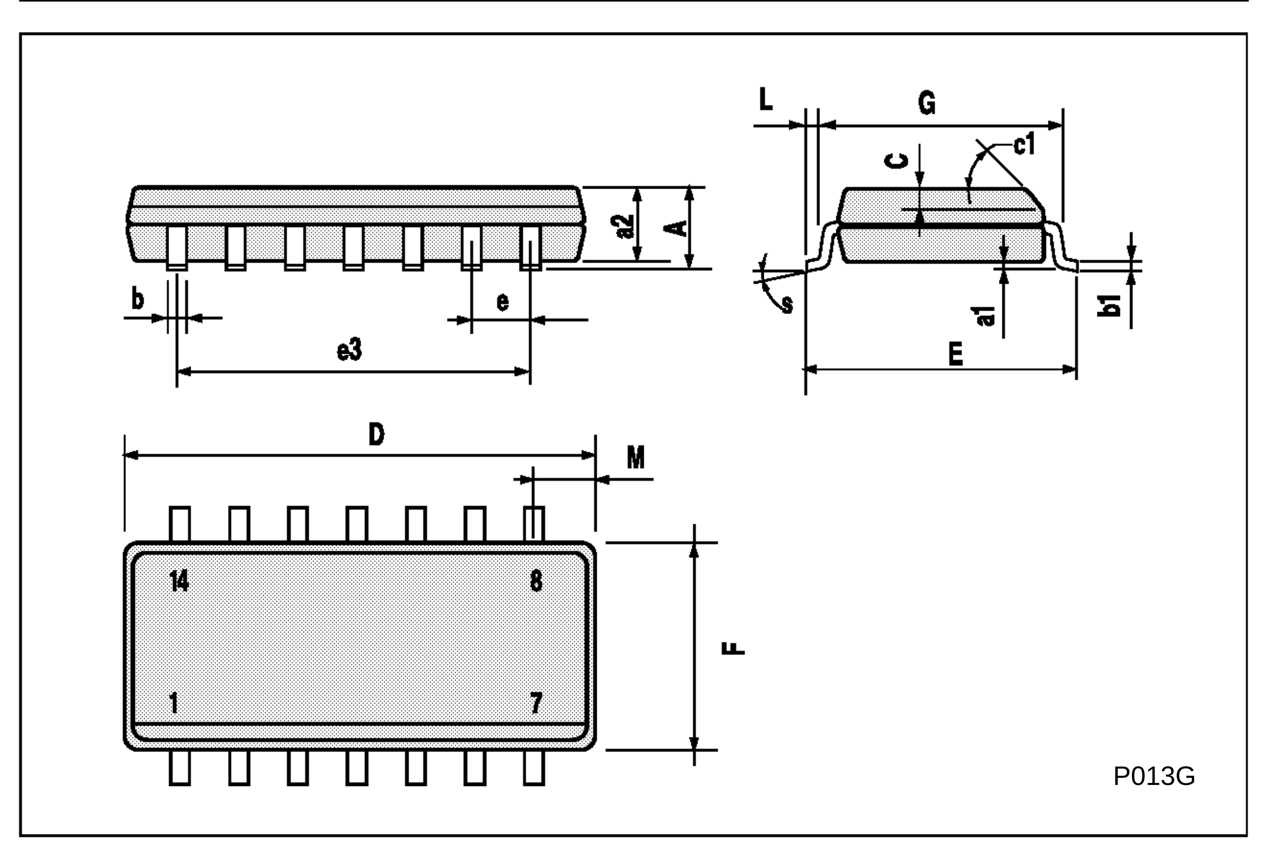
Ceramic DIP14/1 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			20			0.787
B			7.0			0.276
D		3.3			0.130	
E	0.38			0.015		
e3		15.24			0.600	
F	2.29		2.79	0.090		0.110
G	0.4		0.55	0.016		0.022
H	1.17		1.52	0.046		0.060
L	0.22		0.31	0.009		0.012
M	1.52		2.54	0.060		0.100
N			10.3			0.406
P	7.8		8.05	0.307		0.317
Q			5.08			0.200



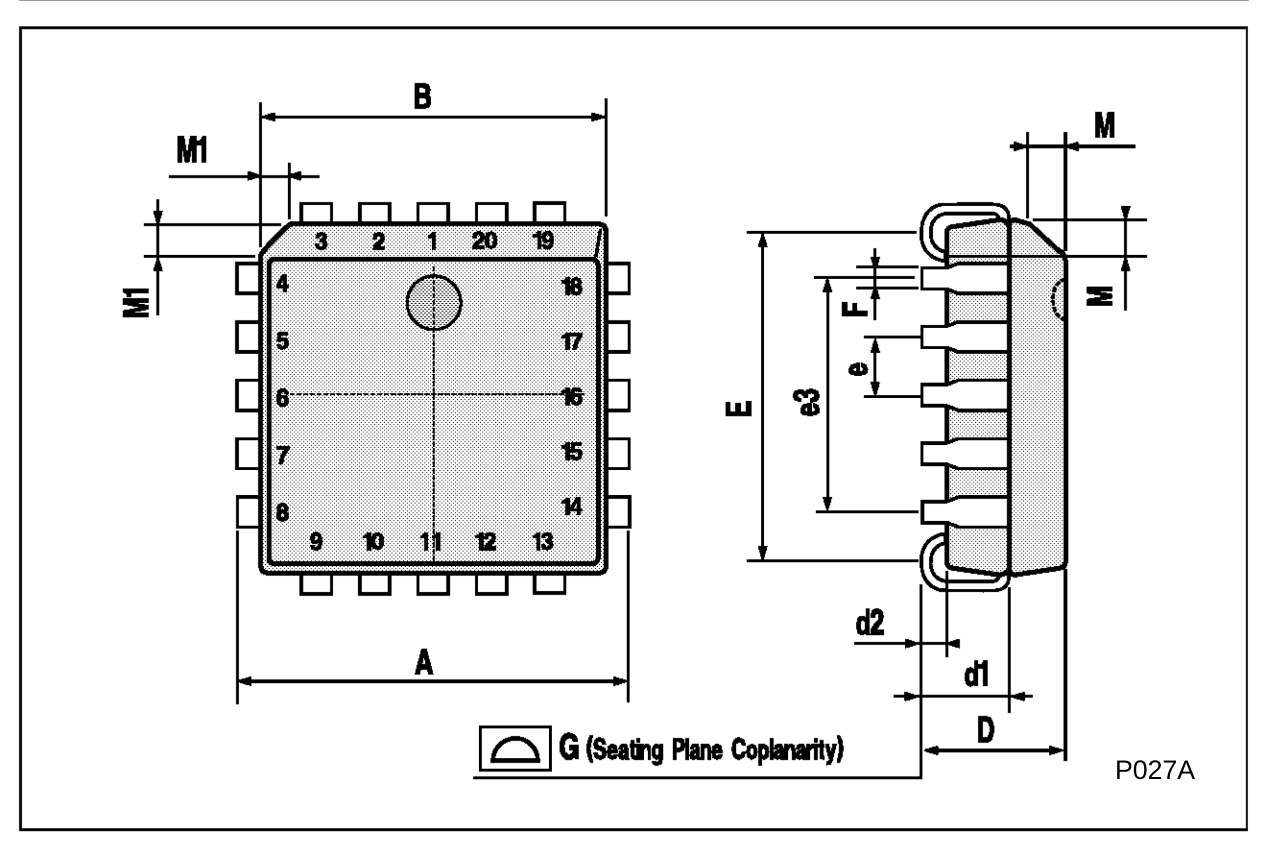
SO14 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.68			0.026
S	8° (max.)					



PLCC20 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	9.78		10.03	0.385		0.395
B	8.89		9.04	0.350		0.356
D	4.2		4.57	0.165		0.180
d1		2.54			0.100	
d2		0.56			0.022	
E	7.37		8.38	0.290		0.330
e		1.27			0.050	
e3		5.08			0.200	
F		0.38			0.015	
G			0.101			0.004
M		1.27			0.050	
M1		1.14			0.045	




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